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# Building Science

Adventures In Building Science

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**Build Tight - Ventilate Right**

Build Tight - Ventilate Right  
How Tight?  
What's Right?

### Air Barrier Metrics

Material	0.02 l/(s-m <sup>2</sup> ) @ 75 Pa
Assembly	0.20 l/(s-m <sup>2</sup> ) @ 75 Pa
Enclosure	2.00 l/(s-m <sup>2</sup> ) @ 75 Pa
	0.35 cfm/ft <sup>2</sup> @ 50 Pa
	0.25 cfm/ft <sup>2</sup> @ 50 Pa
	0.15 cfm/ft <sup>2</sup> @ 50 Pa

Getting rid of big holes	3 ach@50
Getting rid of smaller holes	1.5 ach@50
Getting German	0.6 ach@50

## Best

As Tight as Possible - with -  
Balanced Ventilation  
Energy Recovery  
Distribution and Mixing  
Source Control - Spot exhaust ventilation  
Filtration  
Material selection

Worst

Leaky - with – Nothing

Spot Ventilation in Bathroom/Kitchen

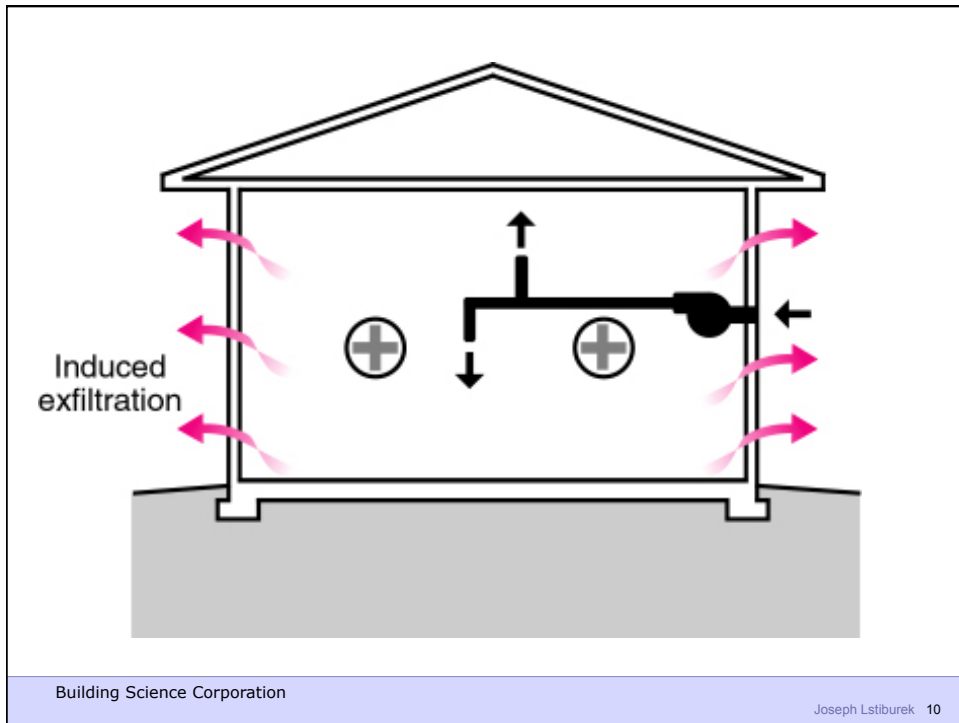
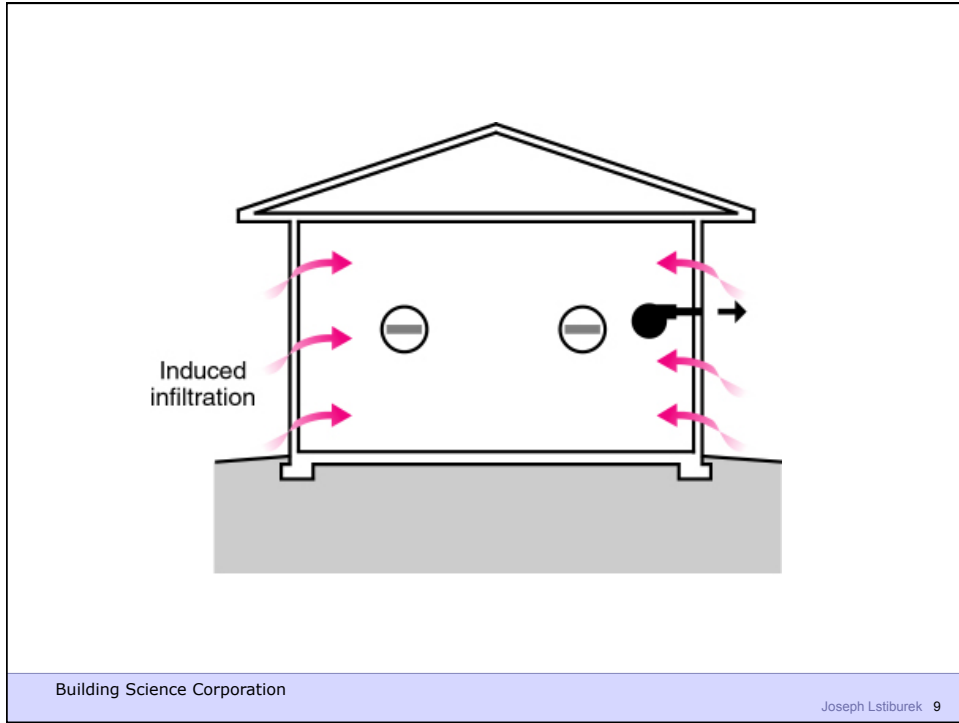
Exhaust Ventilation – with – No Distribution  
and No Mixing

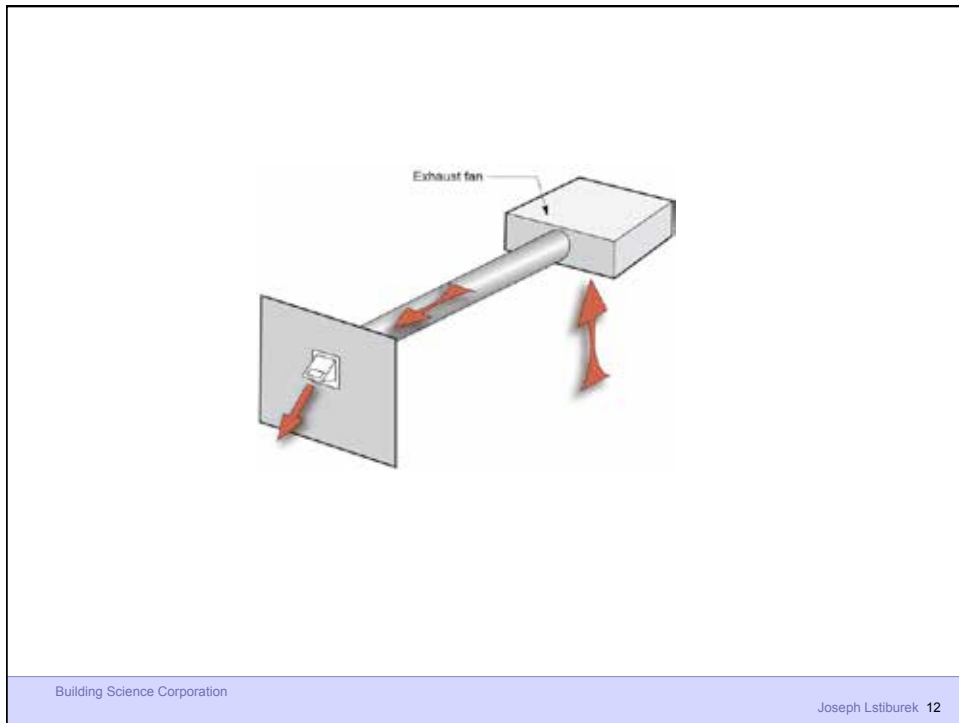
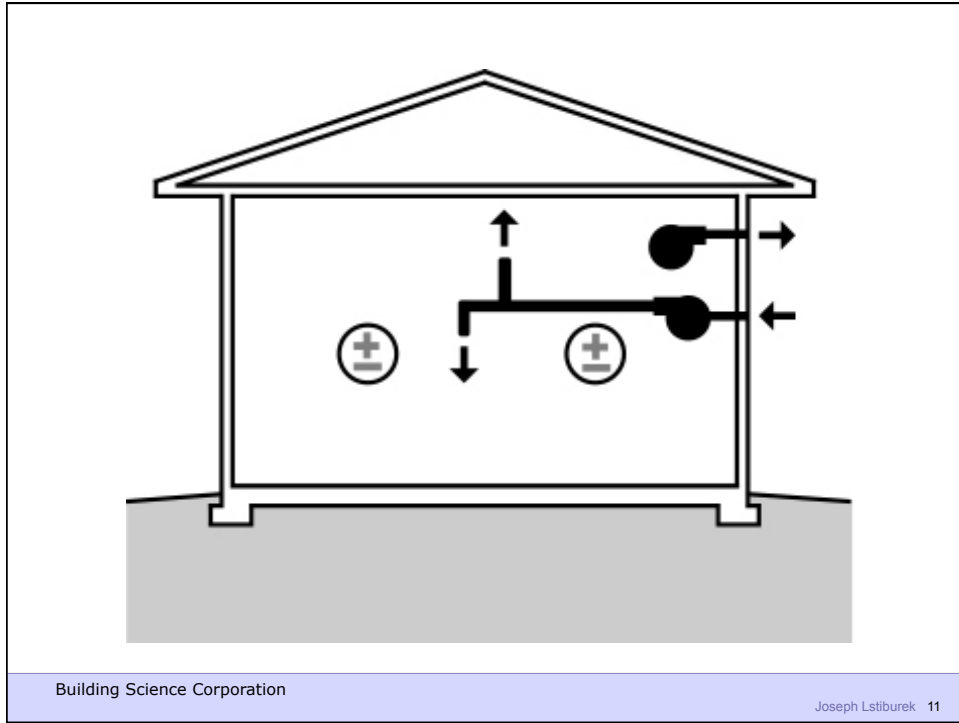
## Three Types of Controlled Ventilation Systems

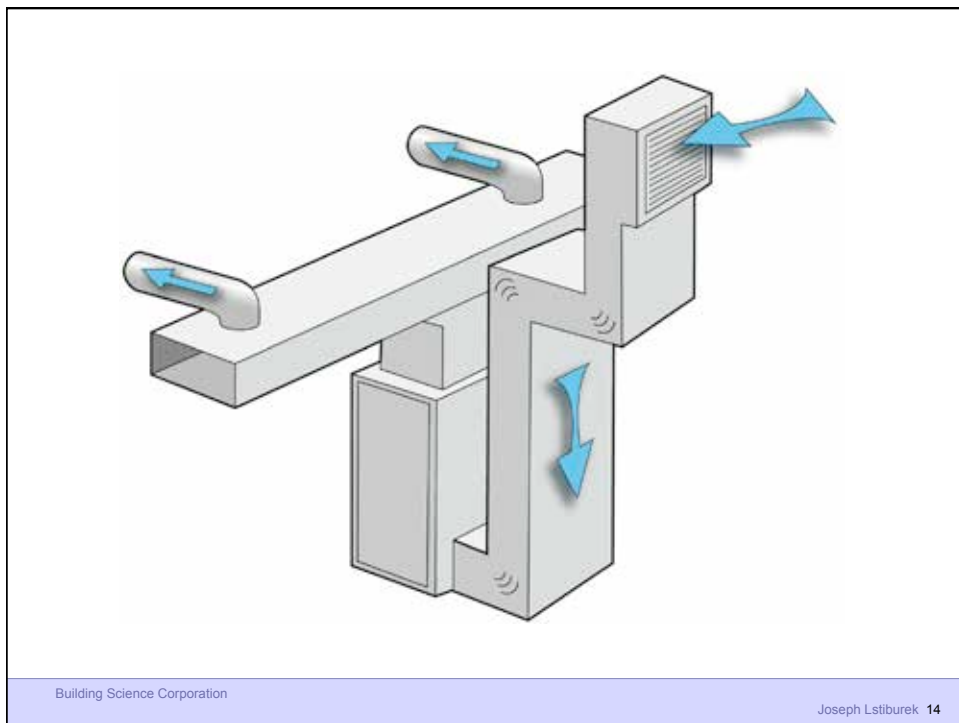
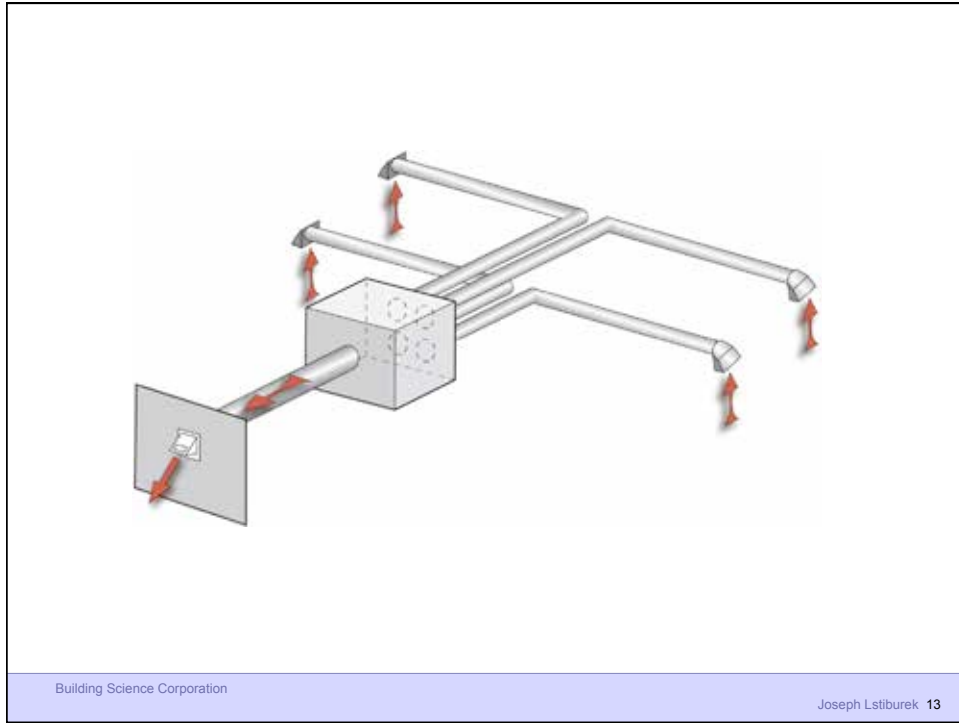
Exhaust Ventilation

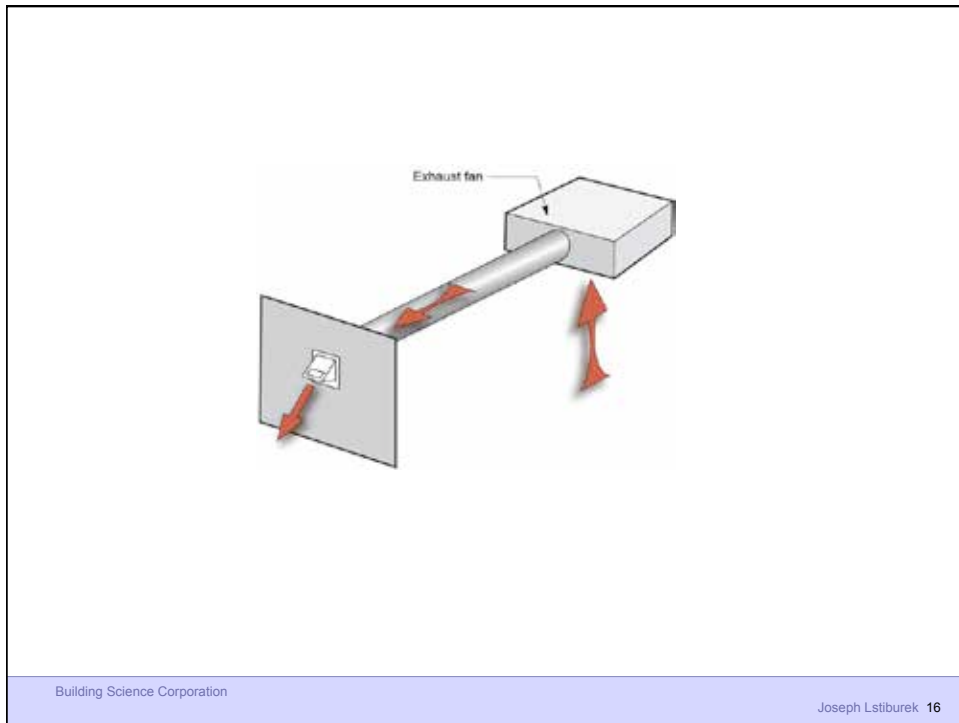
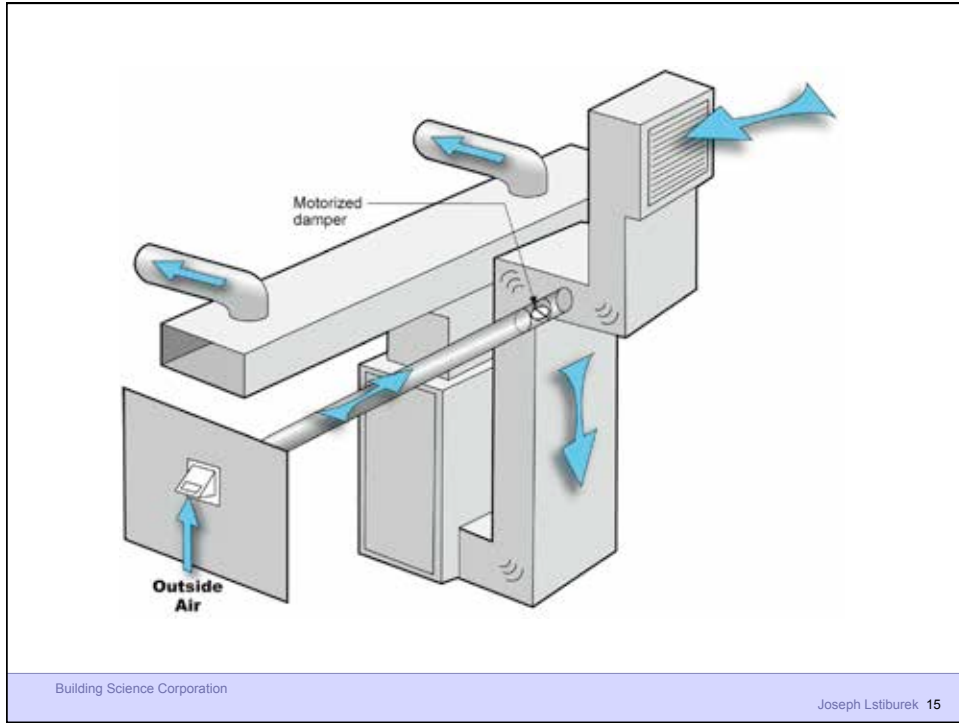
Supply Ventilation

Balanced Ventilation

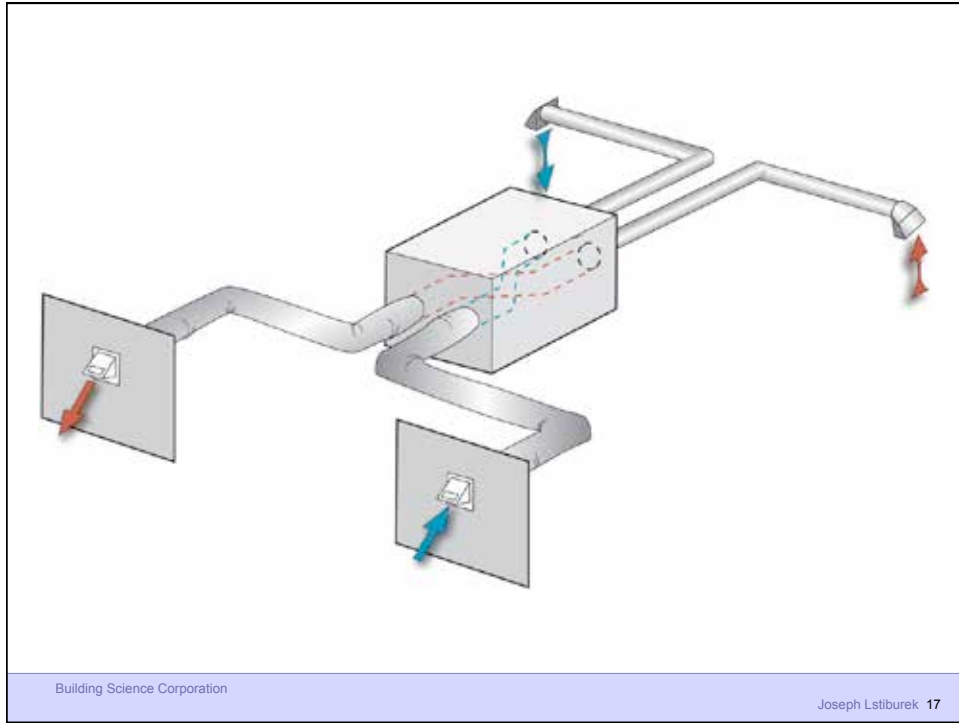












Ventilation Rates Are Based on Odor Control

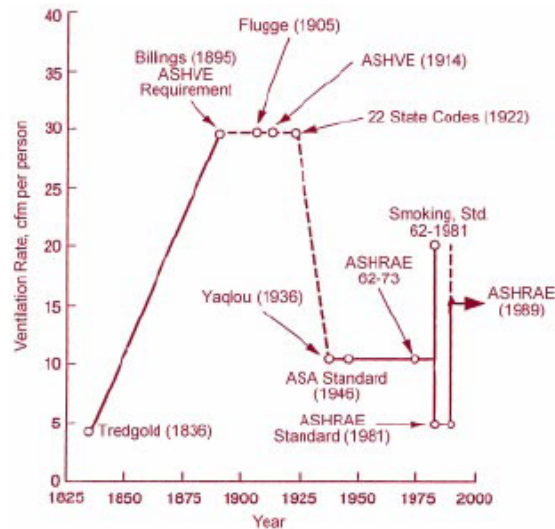
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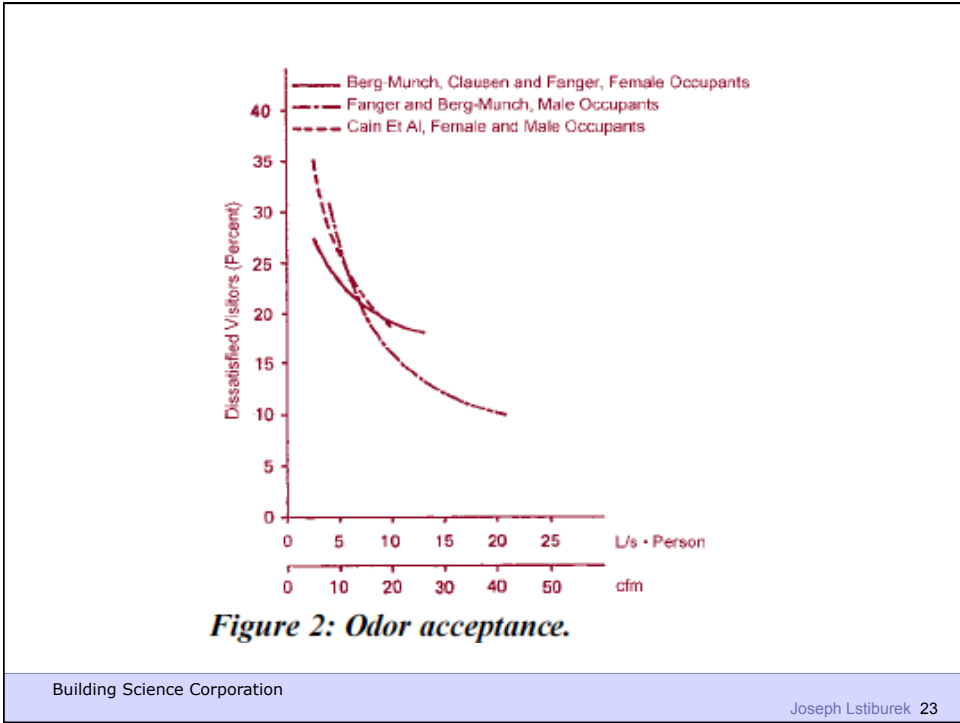
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 The Applicable Studies Focus on Dampness



**Figure 1: Minimum ventilating rate history.**



**House**  
**2,000 ft<sup>2</sup>**  
**3 bedrooms**  
**8 ft. ceiling**  
**Volume: 16,000 ft<sup>3</sup>**

.35 ach    93 cfm  
 .30 ach    80 cfm  
 .25 ach    67 cfm  
 .20 ach    53 cfm  
 .15 ach    40 cfm

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## House

2,000 ft<sup>2</sup>  
 3 bedrooms  
 8 ft. ceiling  
 Volume: 16,000 ft<sup>3</sup>

### Ventilation Rates

.35 ach	93 cfm	62 - 73	5 cfm/person	20 cfm
.30 ach	80 cfm		10 cfm/person	40 cfm
.25 ach	67 cfm	62 - 89	15 cfm/person	60 cfm
.20 ach	53 cfm		.35 ach	90 cfm
.15 ach	40 cfm	62.2 - 2010	7.5 cfm/person	50 cfm
			+ 0.01	
		62.2 - 2013	7.5 cfm/person	90 cfm
			+ 0.03	

## Office

### Occupant Density

15/1000 ft<sup>2</sup> (67 ft<sup>2</sup>/person) 62 - 89  
 15 cfm/person

5/1000 ft<sup>2</sup> (200 ft<sup>2</sup>/person) 62.1 - 2007  
 17 cfm/person

## Correctional Facility Cell

### Occupant Density

20/1000 ft<sup>2</sup> (48 ft<sup>2</sup>/person) 62.1 - 2007  
 10 cfm/person

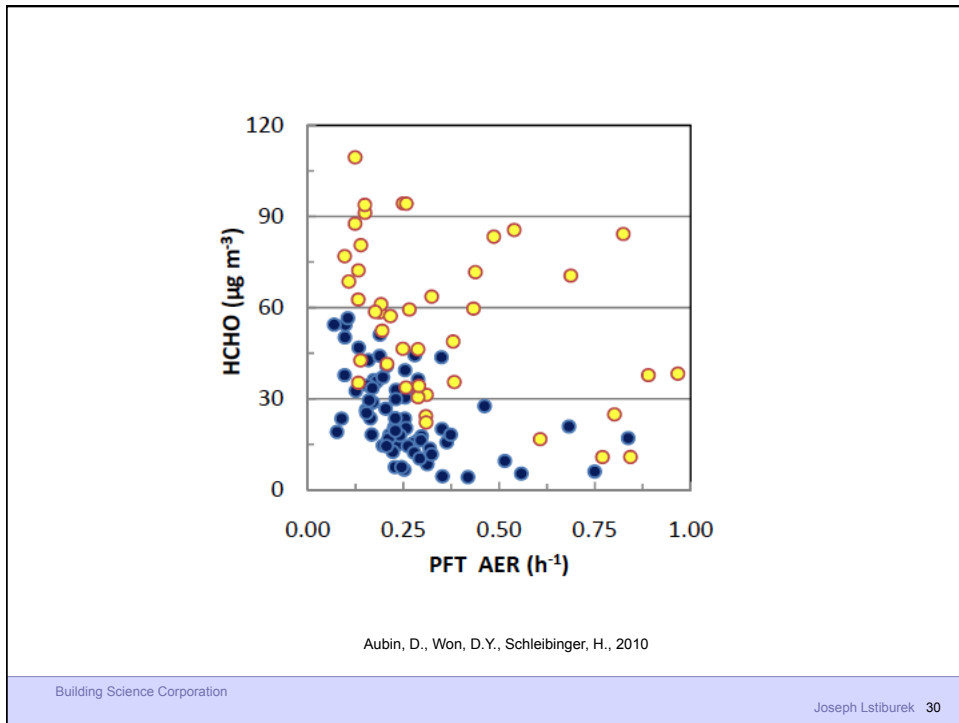
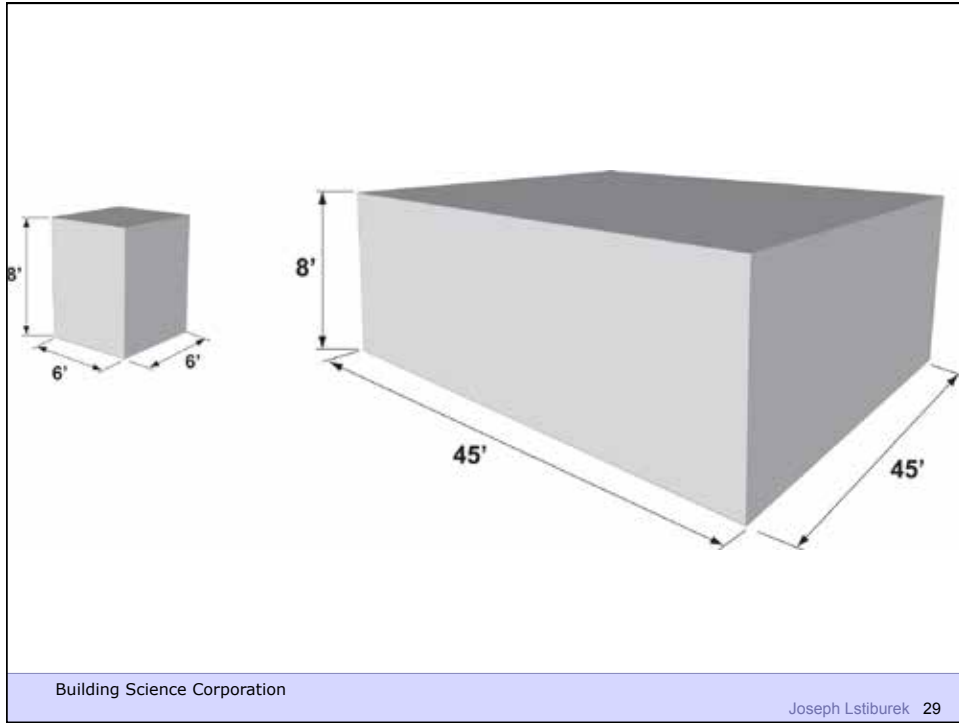
**C.P. Yaglou**

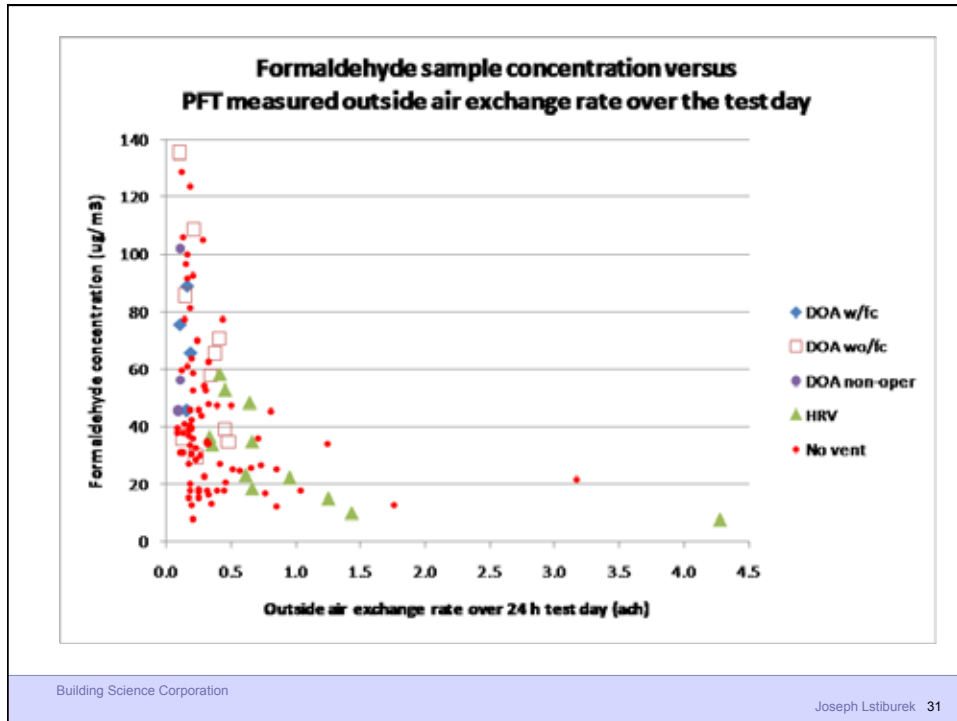
Harvard School of Public Health

**1936****1955**150 ft<sup>3</sup> → 20 cfm/person300 ft<sup>3</sup> → 12 cfm/person**C.P. Yaglou**

Harvard School of Public Health

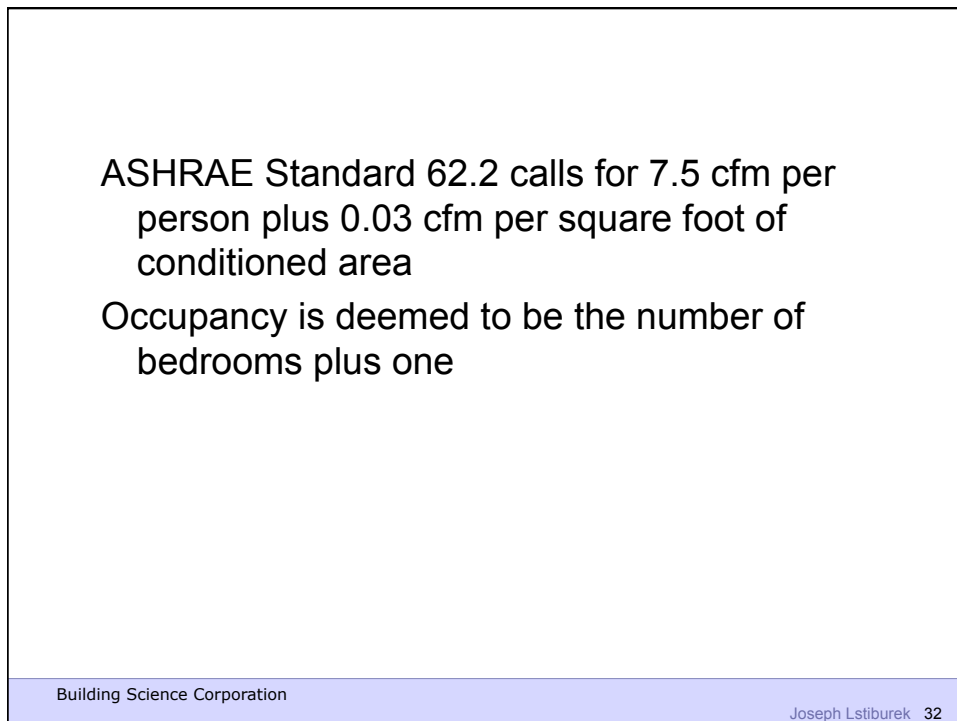
**1936****1955**150 ft<sup>3</sup> → 20 cfm/person 18.75 ft<sup>2</sup> 106 occupants300 ft<sup>3</sup> → 12 cfm/person 37.5 ft<sup>2</sup> 53 occupants**Experiment**470 ft<sup>3</sup> → 59 ft<sup>2</sup>200 ft<sup>3</sup> → 25 ft<sup>2</sup>100 ft<sup>3</sup> → 12 ft<sup>2</sup>





ASHRAE Standard 62.2 calls for 7.5 cfm per person plus 0.03 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one





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Occupancy is deemed to be the number of bedrooms plus one

Outcome is often bad – part load humidity problems, dryness problems, energy problems

IRC 2015 and 2018 calls for 7.5 cfm per person plus 0.01 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one

3 Bedroom House – 2,500 ft<sup>2</sup>  
30 cfm plus 75 cfm  
105 cfm

3 Bedroom House – 2,500 ft<sup>2</sup>  
30 cfm plus 25 cfm  
55 cfm

## The Cult of The Blower Door

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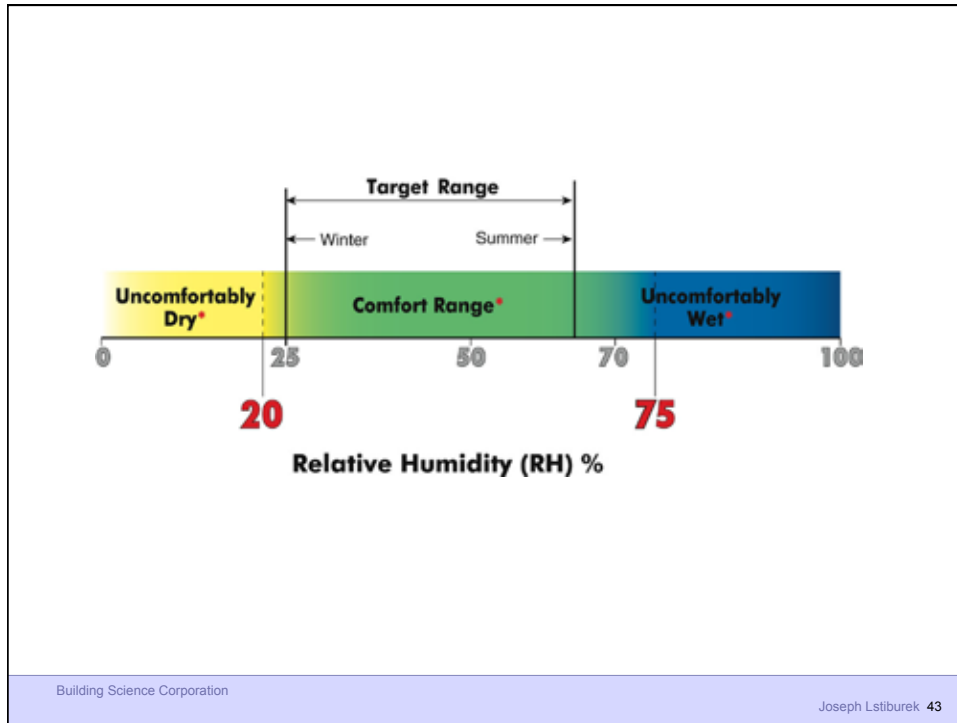
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Blower Door Can't Get You The True ACH  
On A Short Term Basis – Hour, Day, Week

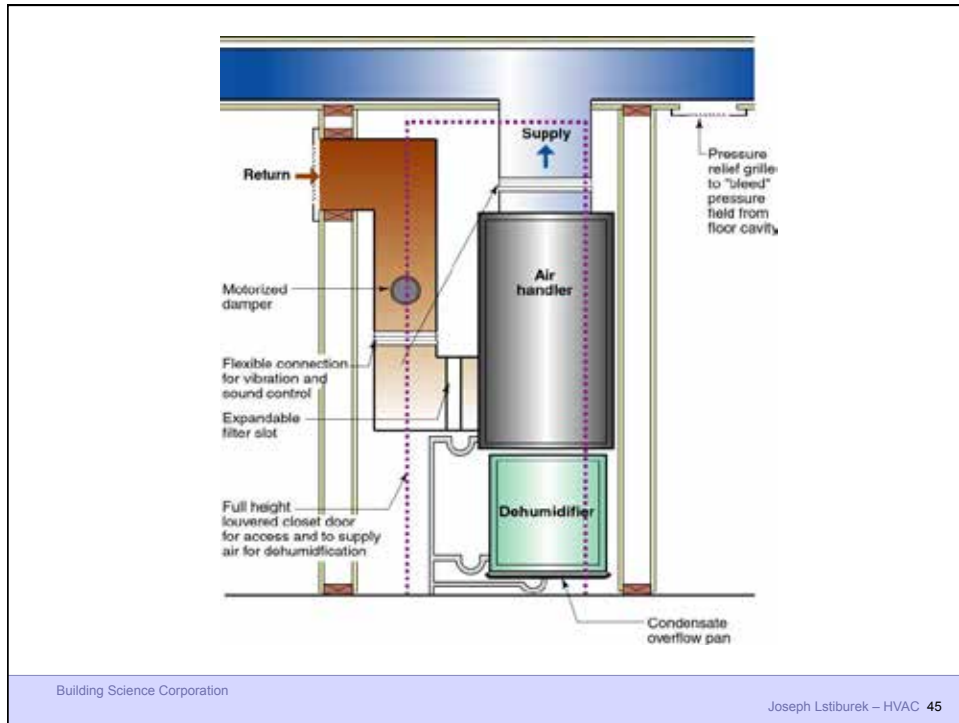
Don't Know Where The Holes Are  
Don't Know The Type of Holes  
Don't Know The Pressure Across The Holes

Dilution Is Not The Solution To Indoor  
Pollution  
Source Control

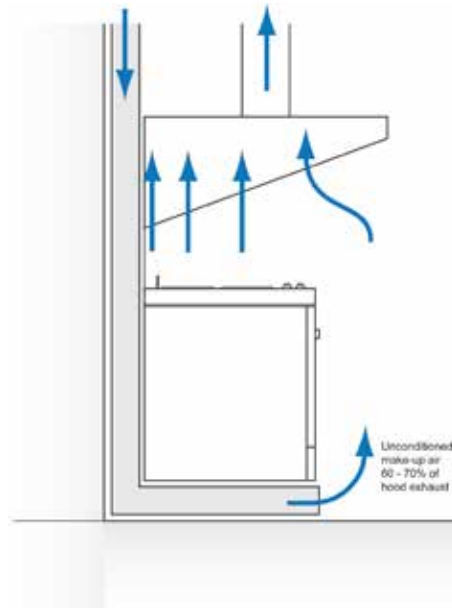
Dilution For People  
Source Control For The Building



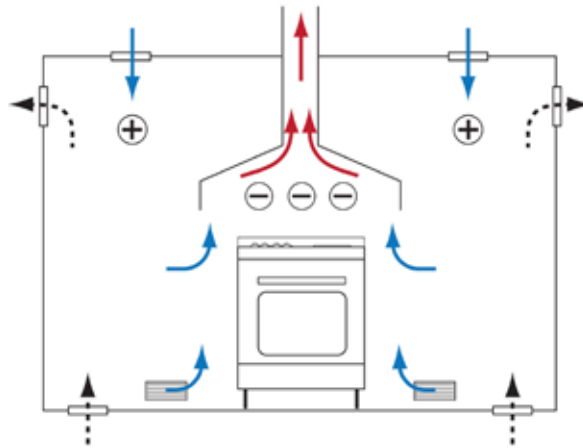
Recommended Range of Relative Humidity  
Above 25 percent during winter  
Below 70 percent during summer

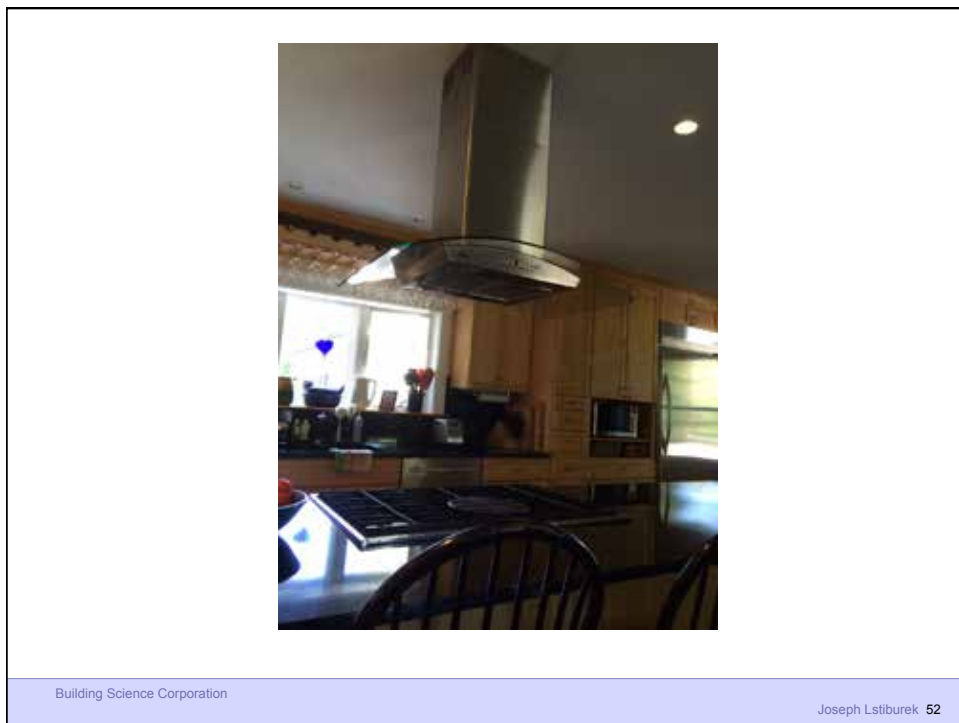
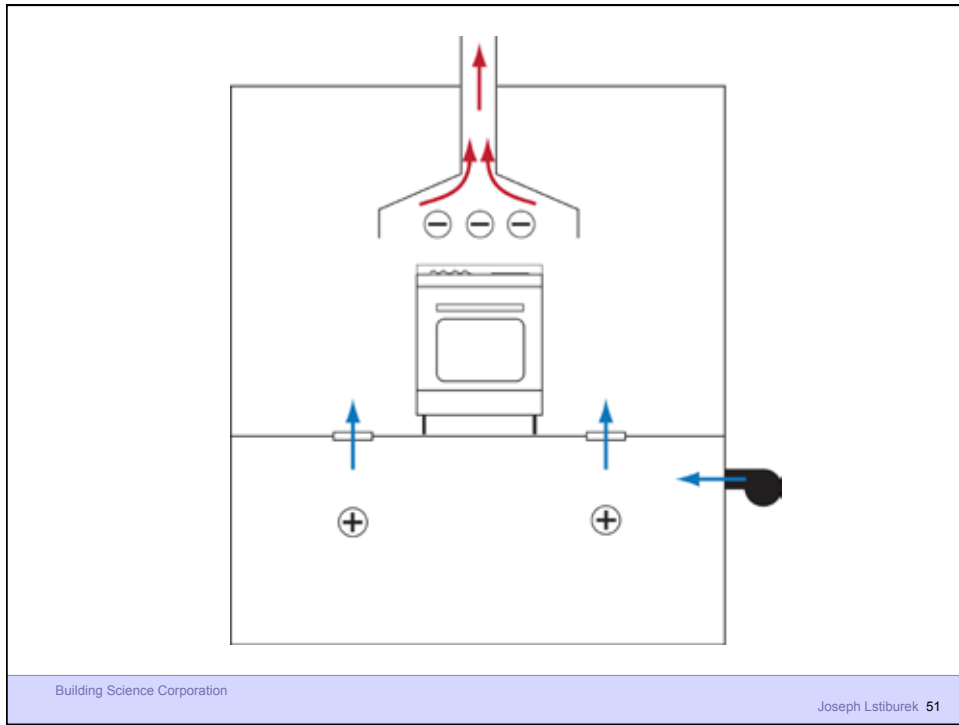


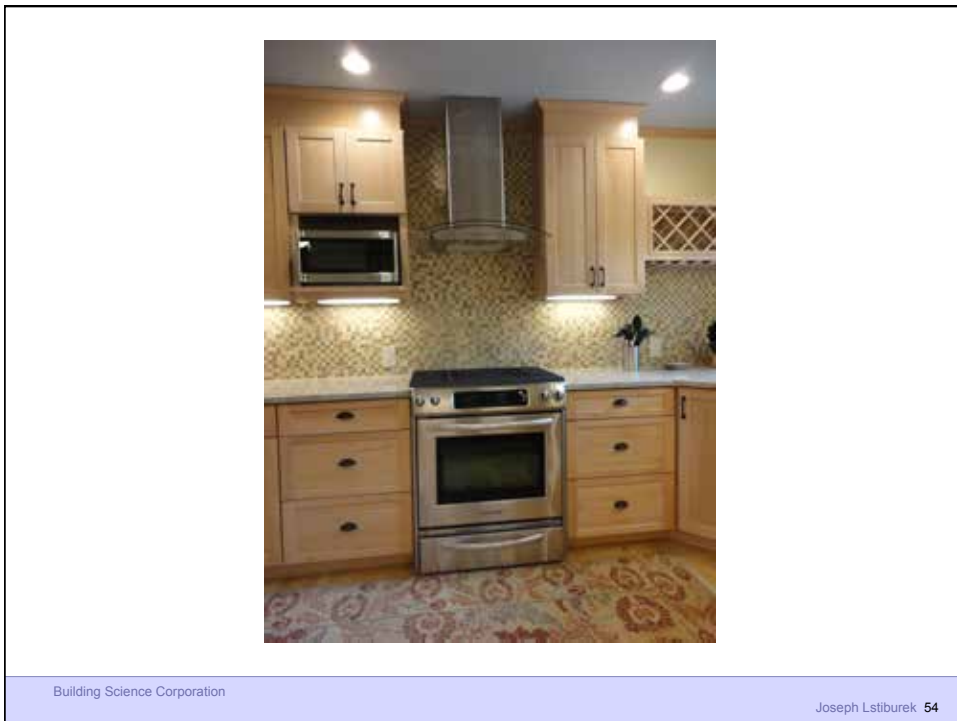
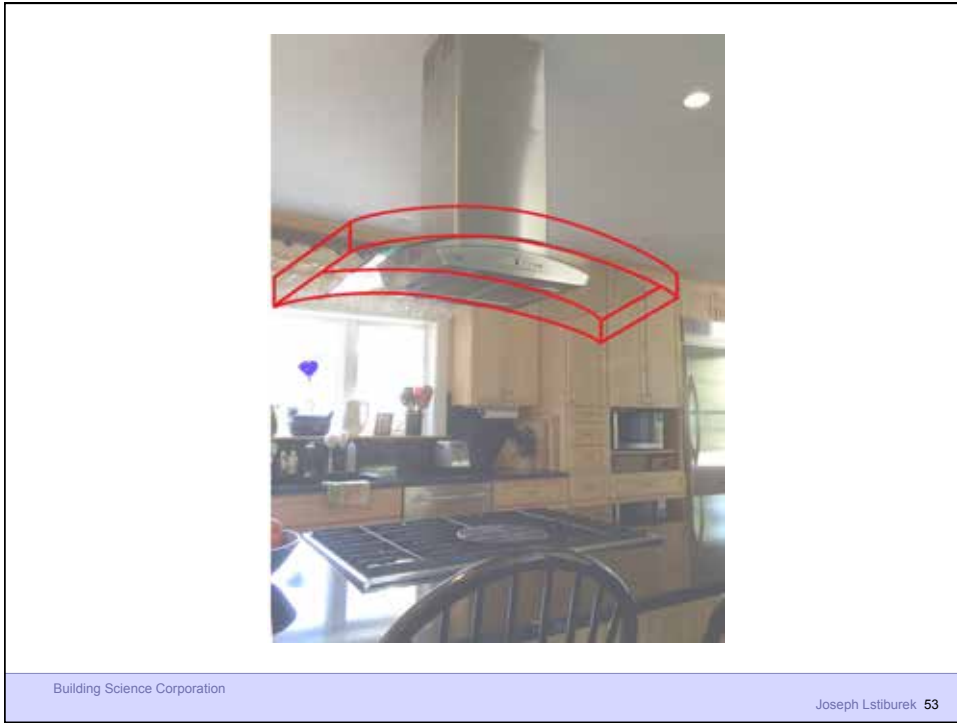
## Kitchen Exhaust Hoods

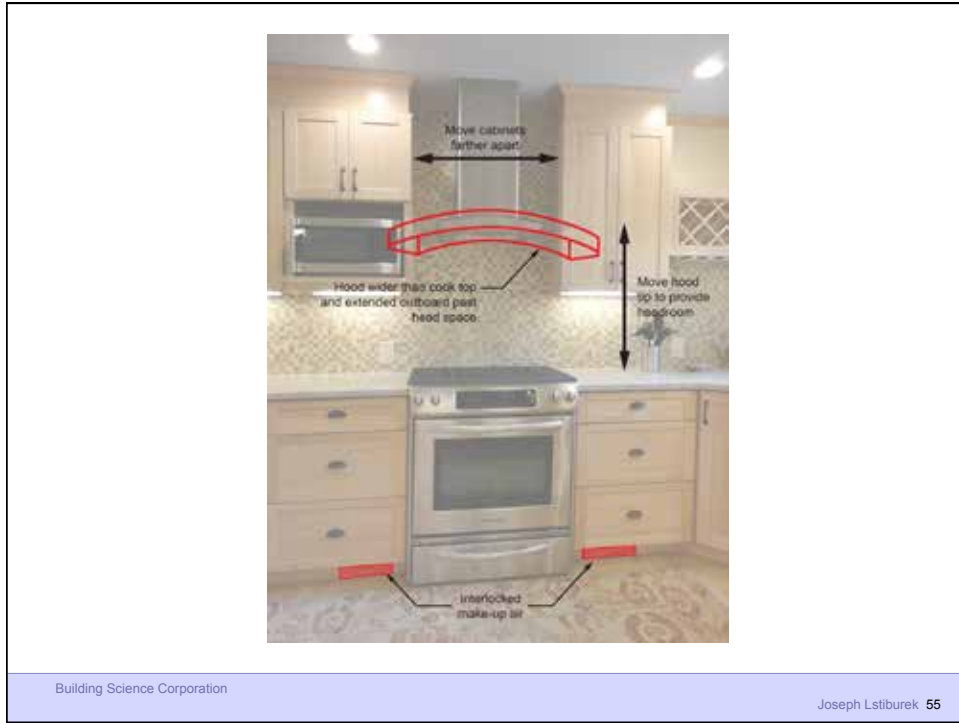












## Clothes Dryers

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## Fireplaces



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## Approaches



